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**Toratani et al.**

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(54) **POWER FEED CONNECTOR**

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***H01R 13/639*** (2006.01)
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CPC ..... ***H01R 13/62*** (2013.01); ***H01R 13/6272*** (2013.01); ***H01R 13/639*** (2013.01); ***H01R 13/641*** (2013.01)

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See application file for complete search history.

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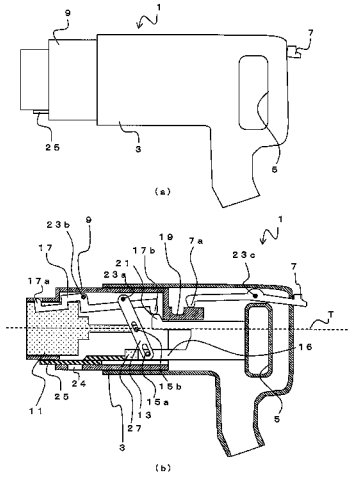
(57) **ABSTRACT**

A case is a cylinder-shaped member and accommodates a connector body in a front end portion thereof. The connector body can slide back and forth with respect to the case. The case is provided with a slider in the inside thereof. One of the end portions of the slider projects forward from the case. The slider can slide in an axial direction. A stopper member is provided near a front end of a connector bar, at the back of the slider. The stopper member touches the slider and can move in response to movement of the slider. The stopper member locks the case and the holding member. That is, the stopper member functions as a case-locking mechanism for preventing the case from moving with respect to a holding member.

**7 Claims, 10 Drawing Sheets**



(51) **Int. Cl.**
***H01R 13/641*** (2006.01)
***H01R 13/627*** (2006.01)

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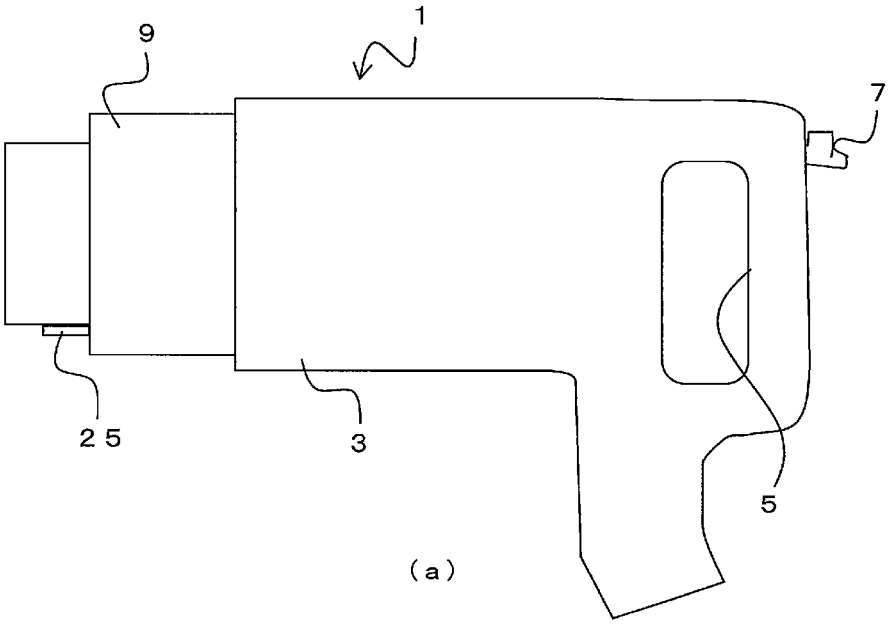
Fig. 1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25
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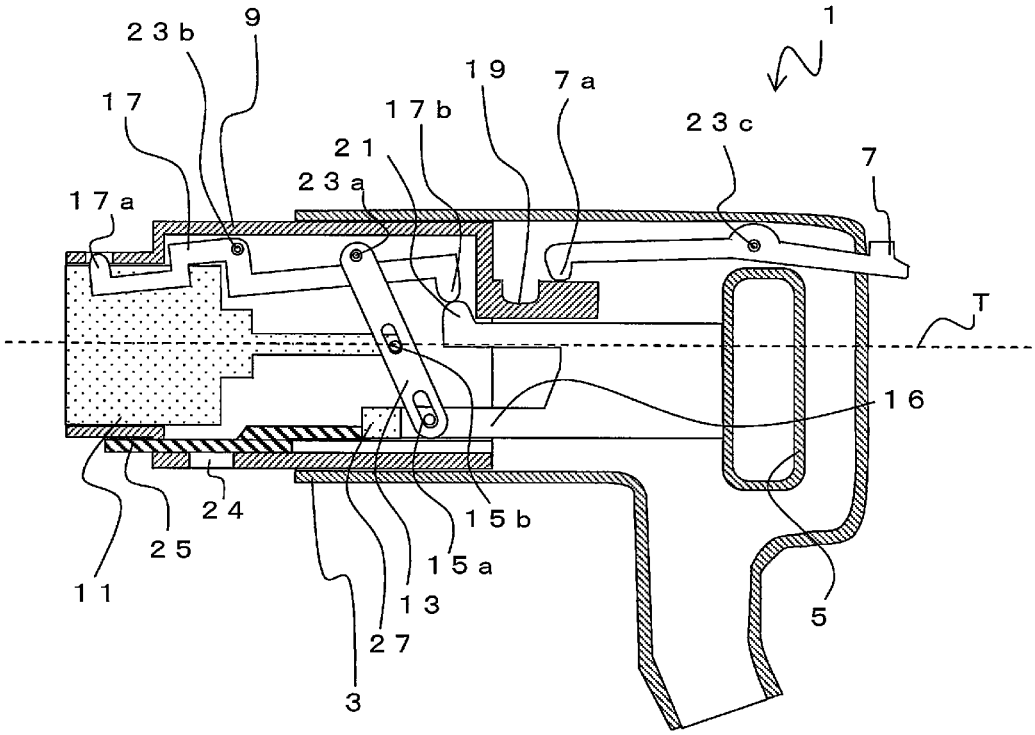
5

(a)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23b
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7a
17
17b
23c
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23a
7
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T
16
24
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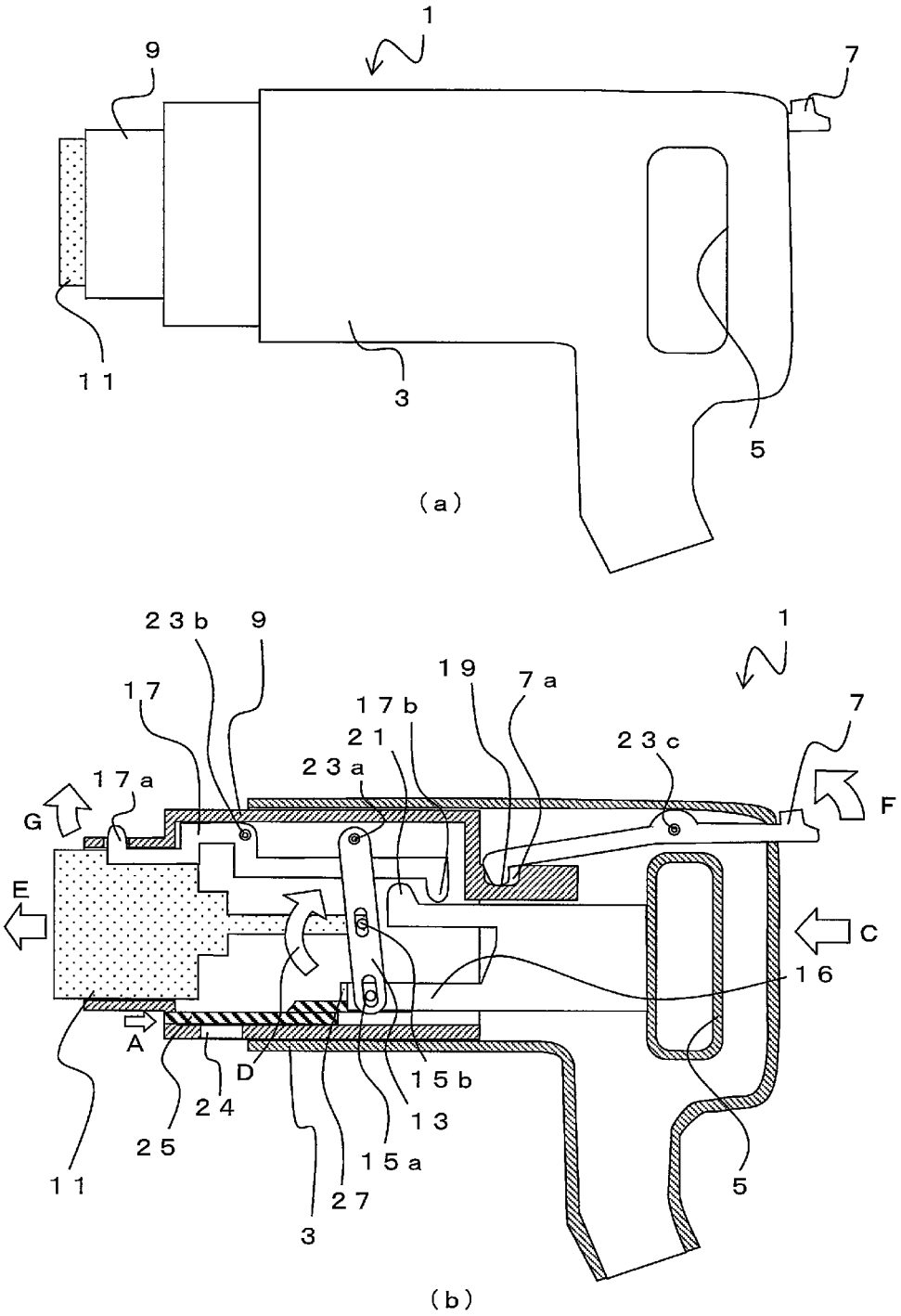
15b
15a
11
13
27
3
5

(b)

Fig. 2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9
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11
3
5
(a)
23b
9
1
19
7a
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17b
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23c
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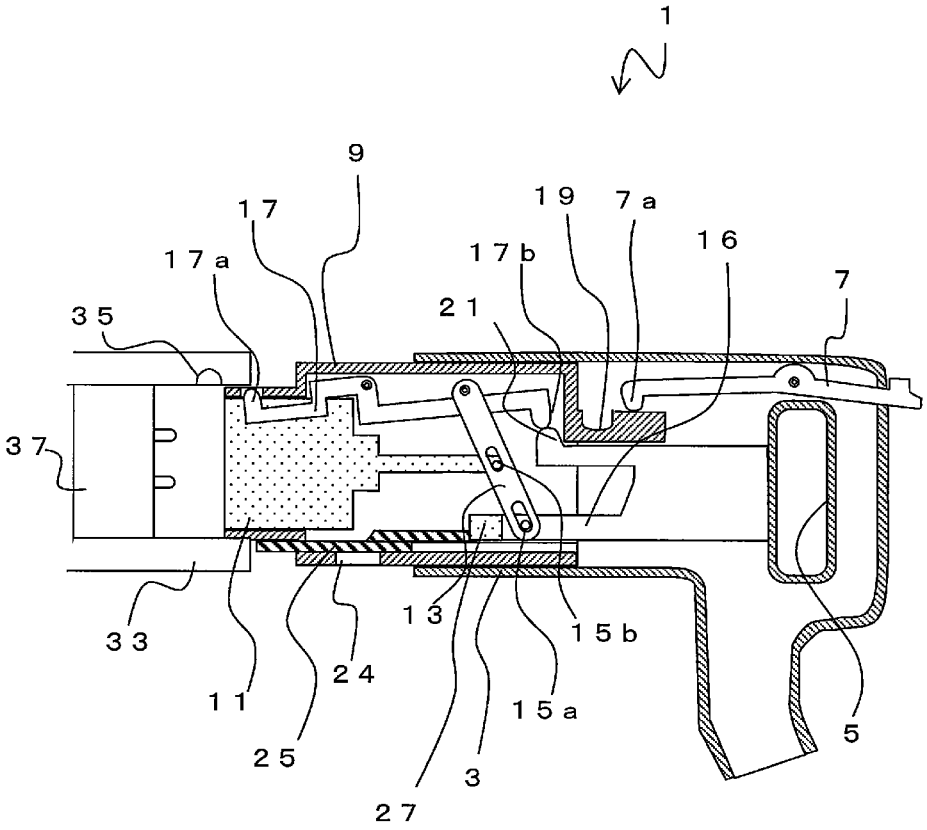
17a
23a
G
F
E
C
16
A
D
15b
24
13
25
15a
11
27
5
3
(b)

Fig. 3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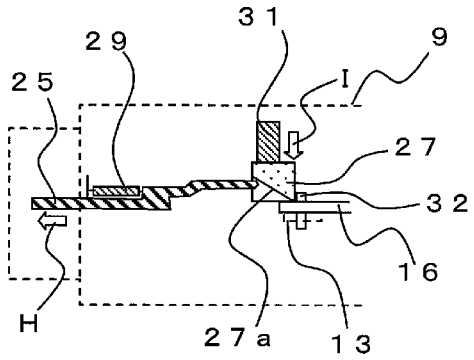
27
3

(a)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9
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I
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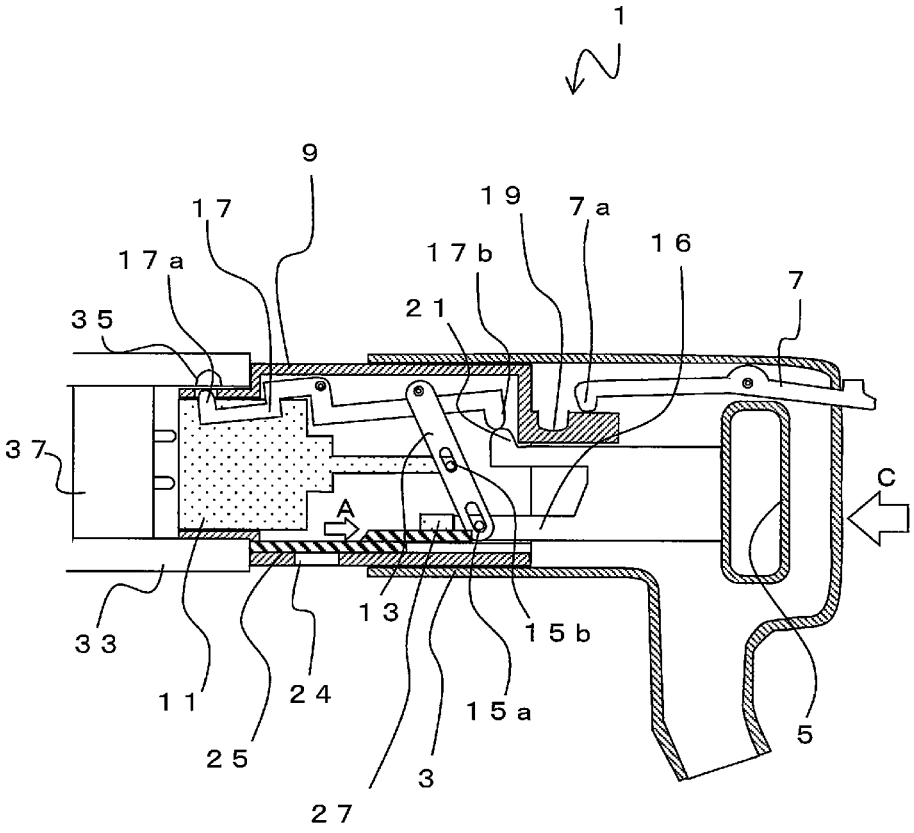
32
16
H
27a
13

(b)

Fig. 4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19
7a
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37
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33
11
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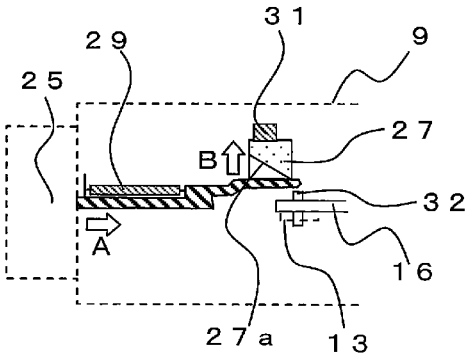
15a
5
3
27

(a)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B
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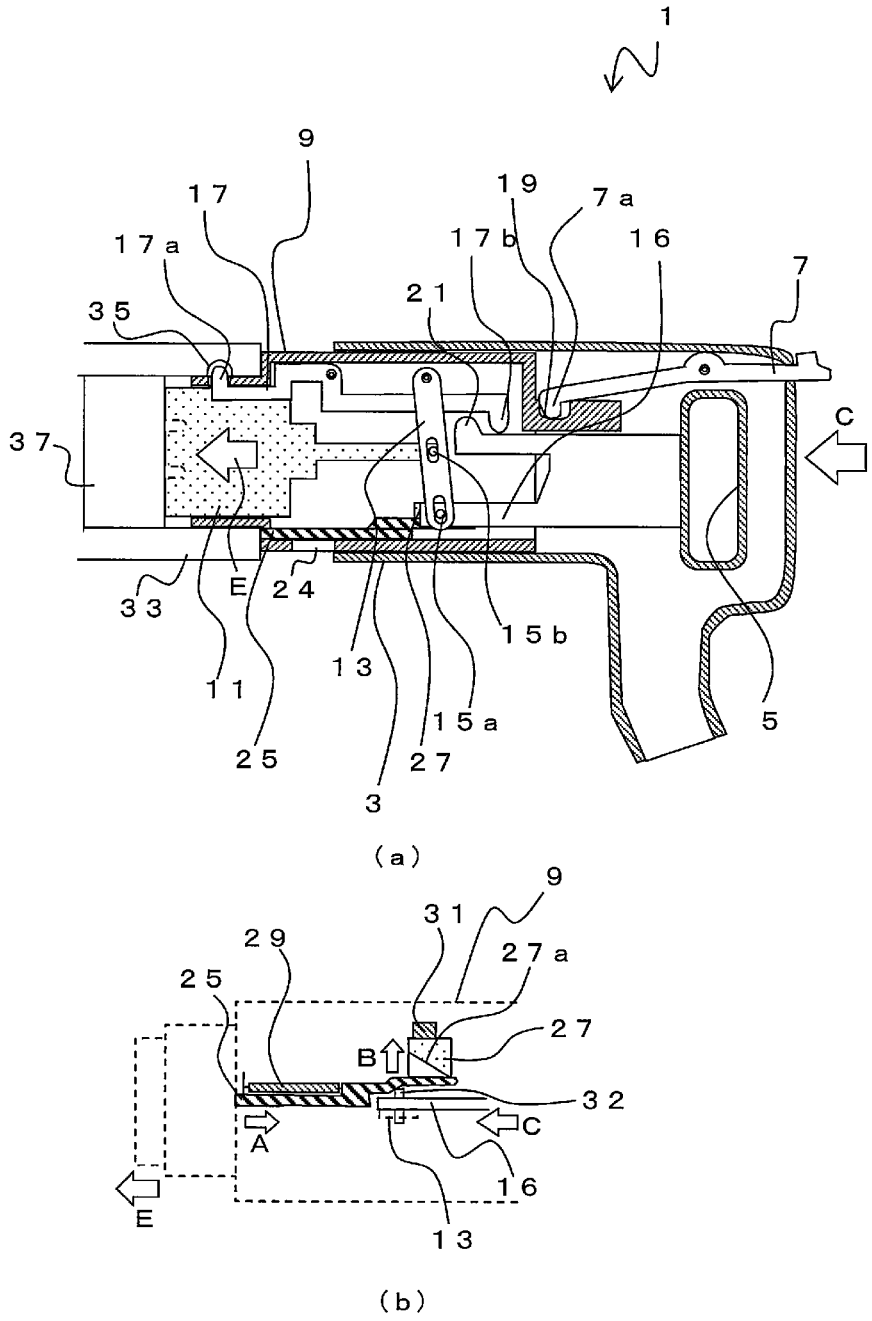
A
16
27a
13

(b)

Fig. 5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15a
15b
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29
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25
27
B
32
A
C
16
E
13
(b)

Fig. 6

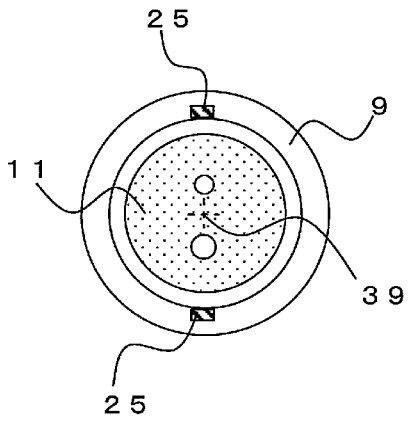
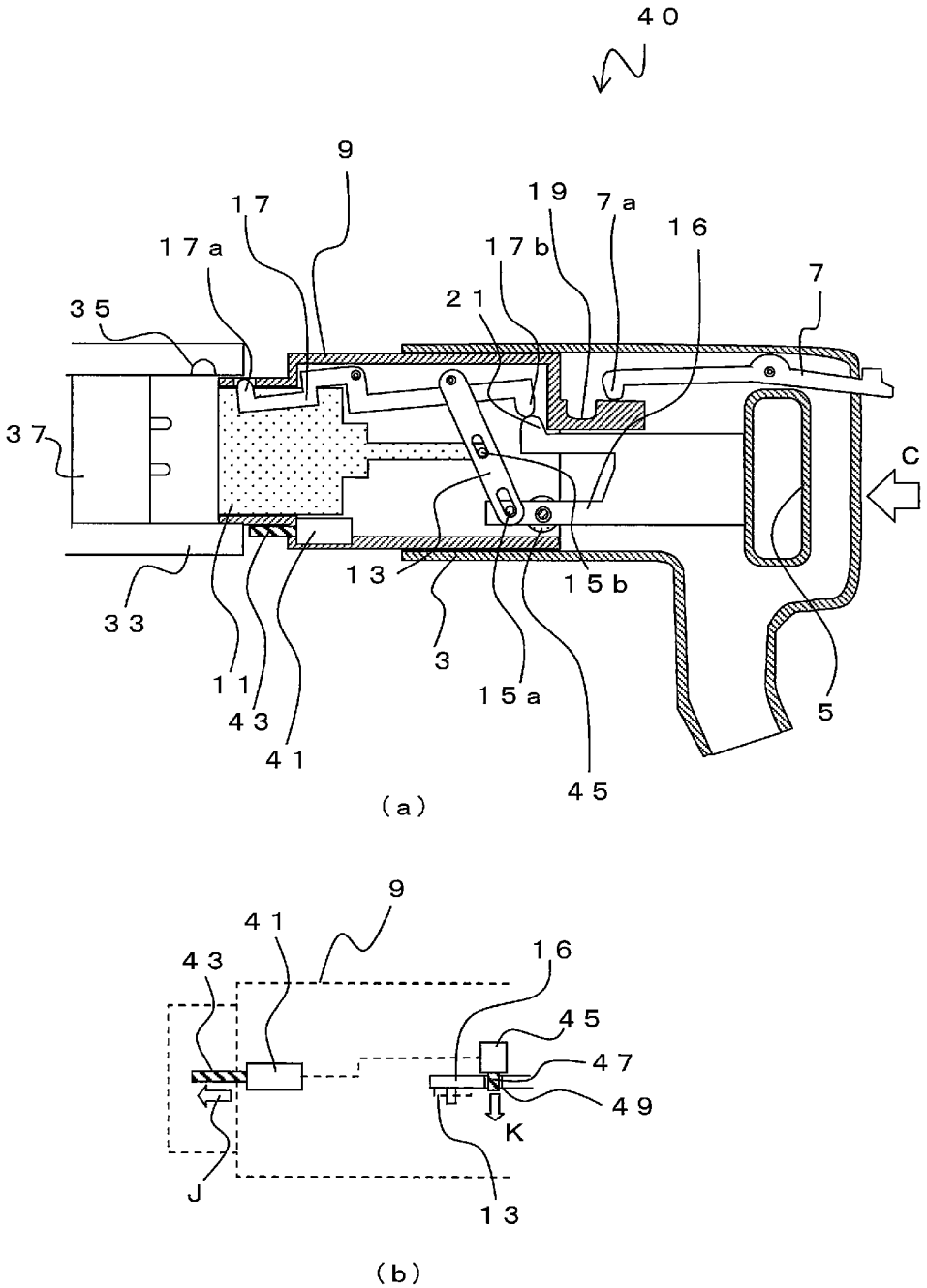


Fig. 7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17b
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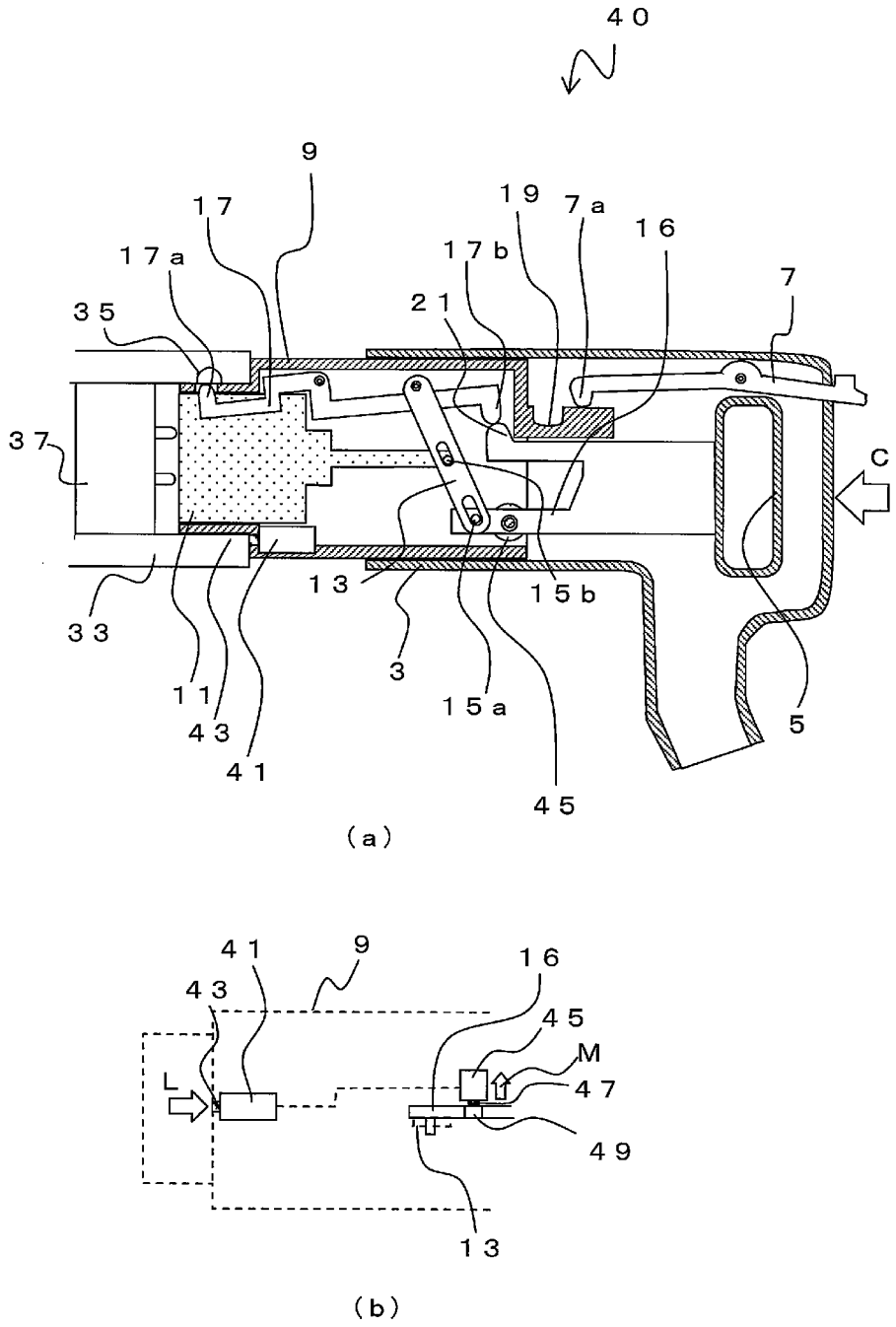
37
C
13
15b
33
3
11
43
41
15a
5
45
(a)
9
41
43
16
45
47
49
K
J
13
(b)

Fig. 8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15b
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11
43
41
15a
45
5
(a)
41
9
16
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M
L
47
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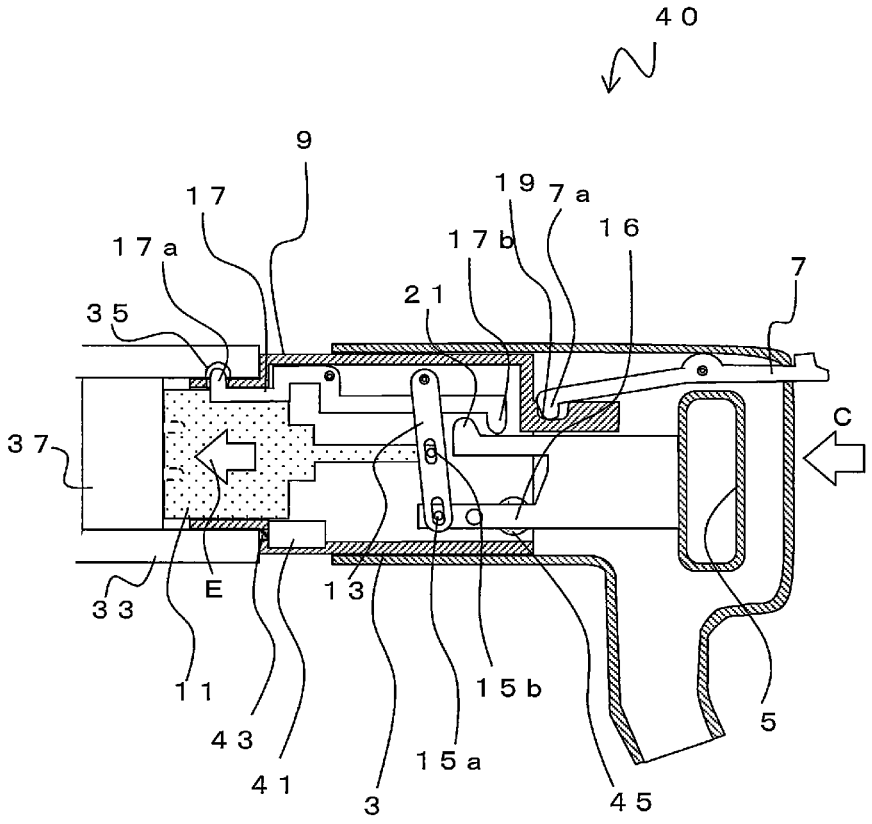
13
(b)

Fig. 9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9
17
17a
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19
7a
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C
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E
33
13
11
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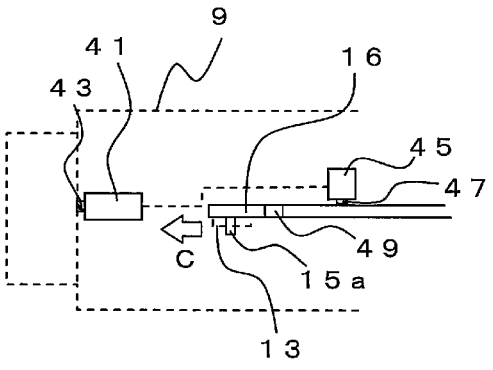
41
3
15a
15b
45
5

(a)


9
41
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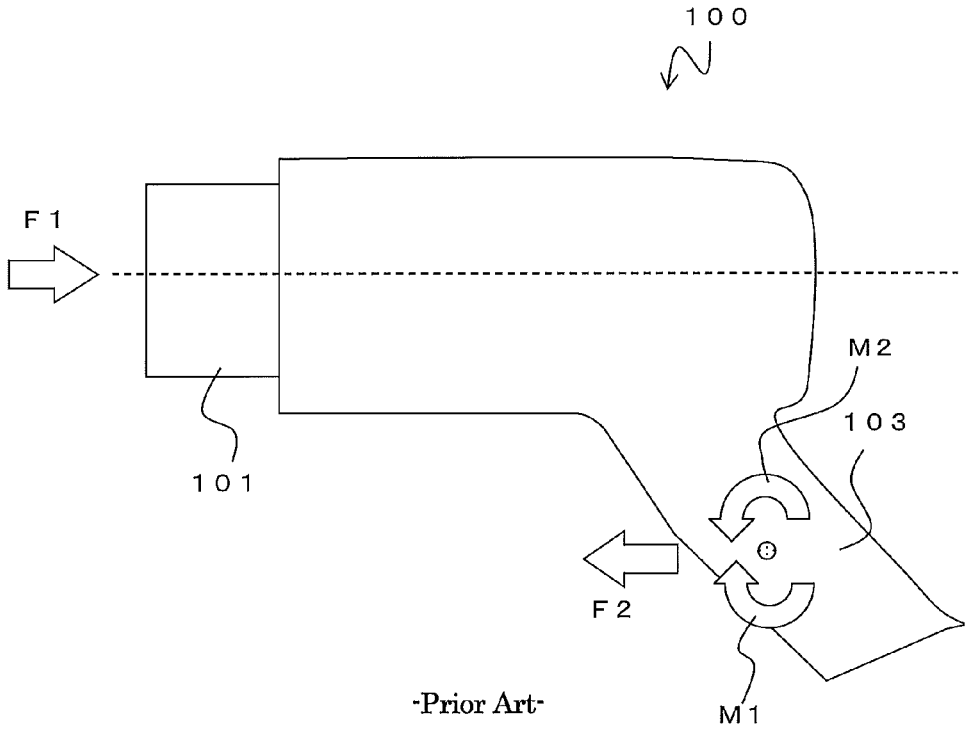
16
45
47
49
C
15a
13

(b)

Fig. 10




-Prior Art-

# POWER FEED CONNECTOR

## RELATED APPLICATIONS

The present application is a continuation of International Application Number PCT/JP2012/076404, filed Oct. 12, 2012, and claims priority from, Japanese Application Number 2011-233563, filed Oct. 25, 2011. The above listed applications are hereby incorporated by reference in their entirety.

## TECHNICAL FIELD

The present invention relates to a power feed connector (power-feeding connector) for boost-charging, which is used for electric vehicles, etc.

## BACKGROUND ART

Recently, electric vehicles that do not make use of fossil fuel have been attracting attention in terms of global environmental issues. An electric vehicle is equipped with a battery for driving and can travel by electricity charged in the battery.

As means for charging a battery of an electric vehicle, there are two methods, that is, a method for charging from a normal household power source and a method for boost-charging with a special charging device. In the method for charging from a household power source, a special connector is not required but a battery tends to be charged during the time while the vehicle is not used such as during nighttime because it takes a long time to charge a battery. On the other hand, in order to continuously drive an electric vehicle for a long distance, it is necessary to perform boost-charging of a battery at charging facilities that are provided in various places in the same manner as conventional charging at gas stations.

As such a power-feeding connector used for electric vehicles, for example, a power-feeding connector comprising a case, a connector body that is slidably attached to the case and accommodates a plurality of terminals therein, a handle that is formed in the shape of a pipe and is slidably attached in the same axial direction as that of the connector body, and a lever, wherein the handle moves forward by rotation of the lever, and thereby the connector body is engaged with a connector body of a power-receiving connector has been known (Patent document 1).

## RELATED ART

### Patent Document

Patent document 1: Japanese Patent Application Laid-Open No. H06-188044

## SUMMARY

When connecting a connector for boost-charging, a relatively large-sized terminal is required to be inserted, and accordingly insertion resistance of the connector becomes large. Regarding this point, the connector provided in Patent Document 1 supports junction between the power-feeding connector and the power-receiving connector by use of the lever. However, there are problems in the technique provided in Patent Document 1 such that it is difficult for a user to recognize when to operate the lever. Furthermore, it is not necessarily easy for a user to connect them because, when a user operates the lever in a state where a space between the each connector and orientations thereof are not in a predetermined state, the connectors fail to be successfully connected with each other. In addition, there is a problem that it is difficult for a user to intuitively know how the connector moves and how the lever is operated.



FIG. **10** is a schematic view of a conventional power-feeding connector **100**. The power-feeding connector **100** is provided with a connector body **101** at an end portion thereof and is connected to a power-receiving connector (not shown). An operator connects them with a handle **103** in the hand. In this process, the operator receives connection resistance F1 (such as insertion friction of a plurality of terminals) occurred between the power-receiving connector and the power-feeding connector, and accordingly the operator needs to push the power-feeding connector with a force F2 that is comparable to the F1.

Furthermore, in the power-feeding connector **100**, the handle **103** is not formed on an extended line of a central axis of the connector body, and accordingly the force F1 causes a moment M1 at the handle **103** and an operator needs to cause a moment M2 of the force against the moment M1. In this way, it is difficult for an operator to know how to keep balance of the force that is required for connecting the connectors, and consequently it becomes difficult to connect them in a sensual way.

The present invention was made in view of such problems, and an object of the present invention is to provide a power-feeding connector used for electric vehicles, which does not require a great force but is easily operated at the time of connection.

In order to achieve the object described above, a first aspect of the present invention provides a power-feeding connector used for an automobile, comprising a connector body, a case that accommodates the connector body therein, a holding member that is attached to the case, and a case-locking mechanism that restricts a movement of the case with respect to the holding member, wherein the connector body and the holding member are slidable in a substantially same axial direction with respect to the case when the case-locking mechanism is unlocked, and the connector body is movable forward with respect to the case with a movement of the holding member when the holding member moves forward with respect to the case in a state where the case-locking mechanism is unlocked.

It is desirable that insertion detecting means of the power-feeding connector include a pin that is formed slidably in an inserting and removing direction of the case, on a portion of the case which inserts into the power-receiving connector, an elastic member that urges the pin in an inserting direction of the case, and a switch that detects the pin resists the elastic member and is pushed, and the case-locking mechanism is a stopper member that locks the case and the holding member and is actuated by electromagnetic solenoid, and when detecting that the pin touches the power-receiving connector and is pushed inwardly to the case, the switch actuates the electromagnetic solenoid to move the stopper member so that the case-locking mechanism is unlocked.

It is desirable the insertion detecting means that detect the case is inserted into a power-receiving connector is included in the power-feeding connector, and the insertion detecting means are configured to unlock the case-locking mechanism when detecting that the case is inserted into the power-receiving connector.

The insertion detecting means may include a slider that is formed slidably in an inserting and removing direction of the case, on a portion of the case which inserts into the power-receiving connector, and an elastic member that urges the slider in an inserting direction of the case, and the case-locking mechanism is a stopper member that locks the case

and the holding member, and when the slider touches the power-receiving connector and is pushed inwardly to the case, the stopper member moves so that the case-locking mechanism is unlocked. In this case, a plurality of sliders may be arranged symmetrically with each other against a central axis of the connector body.

It is desirable that a speed reduction mechanism is provided in the holding member and the holding member and the connector body move with respect to the case via the speed reduction mechanism, and when the holding member moves with respect to the case, a movement distance of the connector body with respect to the case becomes smaller than a movement distance of the holding member with respect to the case.

That the case may be provided with a hole, and a position of the slider in an inside of the case is viewed through the hole.

According to the present invention, when a holding member is pushed with respect to a case, a connector body moves in the same direction that of the holding member. With this configuration, it is possible for an operator to recognize movement of the connector body and understand connecting operations sensually, and thereby the procedures for connecting a power-feeding connector to a power-receiving connector can be performed easier.

Furthermore, because a speed reduction mechanism is provided in the inside of the power-feeding connector so that a movement distance of the connector body is set to be smaller than a movement distance of the holding member, the holding member can be moved with a force smaller than a resistance force that is applied on the connector body at the time of connecting the power-feeding connector and the power-receiving connector. Therefore, the procedures for connecting the connectors can be performed with a smaller force.

Furthermore, insertion detecting means that detect the case is inserted into the power-receiving connector is provided therein. When the insertion detecting means detect that the case is inserted into the power-receiving connector, a case-locking mechanism is unlocked. Accordingly, even if the case is not completely inserted into the power-receiving connector, movement of the connector can be prevented. For example, when a part of the case contacts a periphery of the power-receiving connector, the connector body would not be moved.

Therefore, even when the insertion detecting means are combined with the speed reduction mechanism, the effect above can also be obtained because the speed reduction mechanism does not work before the case is not inserted completely into the power-receiving connector.

The insertion detecting means are configured such that, when a slider that can slide in an inserting and removing direction of the case is urged by an elastic member and the slider touches the power-receiving connector and is pushed inwardly to the case, a stopper member that locks the case and the holding member moves and then the case-locking mechanism is unlocked. With this simple configuration, it is possible to successfully detect that the case is inserted into a charging connector.

In this case, when a plurality of sliders is arranged symmetrically against a central axis of the connector body, a reaction force is equally applied on a central axis of the case because the sliders are pushed backwardly at positions symmetrical against an inserting axis. Therefore, it is possible to insert the case into the power-receiving connector more accurately.

Furthermore, when the connector is configured with a hole provided in the case so that the slider in the inside of the case can be viewed, it is possible to recognize whether the slider is successfully pushed. Therefore, it is possible to successfully determine whether the case is inserted into the power-receiving connector accurately.

Furthermore, a switch and electromagnetic solenoid can be used for the insertion detecting means. With this configuration, it is possible to detect insertion and unlock the case with a smaller force without a mechanism that moves a stopper member by pressing the slider thereon.

## Effect of the Invention

According to the present invention, it is possible to provide a power-feeding connector used for electric vehicles, which does not require a great force but is easily operated at the time of connection.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** illustrates a power-feeding connector **1**, and particularly FIG. **1** (*a*) is a side view and FIG. **1** (*b*) is a cross-sectional side view.

FIG. **2** illustrates a state where a power-feeding connector **1** is operated, and particularly FIG. **2** (*a*) is a side view and FIG. **2** (*b*) is a cross-sectional side view.

FIG. **3** illustrates a state where a power-feeding connector **1** and a power-receiving connector **33** are connected with each other, and particularly FIG. **3** (*a*) is a cross-sectional side view and FIG. **3** (*b*) is a bottom perspective view illustrating operations of a slider **25**, etc.

FIG. **4** illustrates a state where a power-feeding connector **1** and a power-receiving connector **33** are connected with each other, and particularly FIG. **4** (*a*) is a cross-sectional side view and FIG. **4** (*b*) is a bottom perspective view illustrating operations of a slider **25**, etc.

FIG. **5** illustrates a state where a power-feeding connector **1** and a power-receiving connector **33** are connected with each other, and particularly FIG. **5** (*a*) is a cross-sectional side view and FIG. **5** (*b*) is a bottom perspective view illustrating operations of a slider **25**, etc.

FIG. **6** is a front view illustrating an example in which a plurality of sliders **25** is provided.

FIG. **7** illustrates a state where a power-feeding connector **40** and a power-receiving connector **33** are connected with each other, and particularly FIG. **7** (*a*) is a cross-sectional side view and FIG. **7** (*b*) is a bottom perspective view illustrating operations of a switch **41**, etc.

FIG. **8** illustrates a state where a power-feeding connector **40** and a power-receiving connector **33** are connected with each other, and particularly FIG. **8** (*a*) is a cross-sectional side view and FIG. **8** (*b*) is a bottom perspective view illustrating operations of a switch **41**, etc.

FIG. **9** illustrates a state where a power-feeding connector **40** and a power-receiving connector **33** are connected with each other, and particularly FIG. **9** (*a*) is a cross-sectional side view and FIG. **9** (*b*) is a bottom perspective view illustrating operations of a switch **41**, etc.

FIG. **10** illustrates a conventional power-feeding connector **100**.

## DESCRIPTION OF SOME EMBODIMENTS

Hereinafter, an embodiment according to the present invention will be described with reference to the drawings. FIG. **1** is a schematic view of a power-feeding connector **1**, and particularly FIG. **1** (*a*) is a side view and FIG. **1** (*b*) is a cross-sectional side view. In the present invention, a state illustrated in FIG. **1** is called a normal state. Also, a cable, etc.

is not illustrated in the following drawings. The power-feeding connector **1** mainly includes a holding member **3**, a case **9**, and a connector body **11**.

As illustrated in FIG. **1** (*a*) and FIG. **1** (*b*), the holding member **3** is provided with a handle **5** at one of the end portions (backward) thereof. The handle **5** is a portion to be held in the hand when an operator operates the power-feeding connector **1**. The handle **5** is formed such that at least a part of the handle **5** is set on an extended line of a central axis of the connector body (illustrated as the line T in FIG. **1** (*b*), a central axis in a movement direction of the connector body **11**, which is described below). With this configuration, when pushing the holding member **3**, it is possible to prevent a moment from being generated with a reaction force of interconnection resistance between the connectors, and thereby it becomes easy to operate the power-feeding connector.

The holding member **3** can accommodates various constituent elements in the inside thereof. A case **9** is provided at the other end portion (forward) of the holding member **3**. A portion near a front end portion of the holding member **3** is formed in the shape of a cylinder, and a part of the case **9** (a back portion) is accommodated in the inside of the holding member **3**. The holding member **3** can slide back and forth with respect to the case **9**.

The case **9** is a cylinder-shaped member and accommodates the connector body **11** in a front end portion thereof. The connector body **11** can slide back and forth with respect to the case **9**. On respective portions on which the holding member **3** and the connector body **11** slide with respect to the case **9**, a guiding mechanism (not shown) and a stopper for restricting the sliding range may be arranged.

The case **9** is provided with an arm **13** in the inside thereof. A portion near one of the end portions of the arm **13** is rotatably attached to the case **9** by a pin **23***a*. A portion near the other end portion of the arm **13** is coupled, by a connecting part **15***a*, to a connector bar **16** that is joined with the holding member **3**. The arm **13** includes a long hole formed therein and the connector bar **16** includes a pin, etc. formed thereon so that the arm **13** and the connector bar **16** are rotatably connected by the connecting part **15***a*.

A substantially central portion (a portion between the pin **23***a* and the connecting part **15***a*) of the arm **13** is connected to the connector body **11** by the connecting part **15***b*. The connecting part **15***b* is configured in the same manner as the connecting part **15***a*. Therefore, when the arm **13** rotates, the connector body **11** and the holding member **3** can move in the straight line with respect to the case **9** in connection with rotary of the arm **13**.

The case **9** is provided with a locking member **17** formed in the inside thereof. The locking member **17** is rotatably attached to the case **9** by a pin **23***b*. A locking pin **17***a* is formed on an end portion at a front side of the locking member **17** so as to be faced upwardly. The locking pin **17***a* is placed on a position of a hole that is formed in the case **9**.

An engaging part **17***b* is formed on an end portion at a back side of the locking member **17** so as to be faced downwardly. The engaging part **17***b* is formed convexly so that the engaging part **17***b* and an engaging part **21** can be engaged with each other. The engaging part **21** is fixed on the part of holding member **3**. In the normal state, the engaging parts **17***b* and **21** are not engaged with each other but a projection of the engaging part **17***b* is set on a projection of the engaging part **21**. Furthermore, in the normal state, the engaging part **17***b* is pushed upwardly by the engaging part **21**, and accordingly the locking pin **17***a* does not project from the case **9** (the hole formed in the case **9**) and remains within the case **9** via the pin **23***b*.

The holding member **3** is provided with an operating part **7** in the inside thereof. The operating part **7** is rotatably attached to the holding member **3** by a pin **23***c*. An end portion at a back side of the operating part **7** projects from the holding member **3** toward an outside so that an operator can operate the operating part **7** from the outside. A locking pin **7***a* is formed at a front side of the operating part **7** so as to be faced downwardly. The locking pin **7***a* touches a part of the case **9**, and thus the locking pin **7***a* is pushed upwardly by the part of the case **9** in the normal state. A concave part **19** that enables the locking pin **7***a* to be engaged therewith is provided at a front side of a portion, which touches the locking pin **7***a* in the normal state, of the case **9**.

The case **9** is provided with a slider **25** in the inside thereof. One of the end portions of the slider **25** projects forward from the case **9**. That is, a step is formed in front of the case **9** and the slider **25** is exposed on the step. The slider **25** can slide in an axial direction (in a movement direction of the case **9** as well as an inserting and removing direction of the connector).

A hole **24** is formed at a part of the case **9**. A position of the slider **25** in the inside of the case **9** can be viewed through the hole **24**. The arrangement of the slider **25** and the hole **24** is not limited to the example illustrated in the drawings, however, they can be suitably arranged. For example, the hole **24** may be arranged on a top surface or a side surface of the case **9** and the slider **25** may be arranged on a top portion or a side surface of the power-feeding connector in order to make them easier to be visually recognized.

A stopper member **27** is provided near a front end portion of the connector bar **16**, at the back of the slider **25**. The stopper member **27** touches the slider **25** and is configured to be movable in response to movement of the slider **25**. The stopper member **27** locks the case **9** and the holding member **3**. That is, the stopper member **27** functions as a case-locking mechanism to prevent the case **9** from moving with respect to the holding member **3**. The details of mechanisms and operations of the slider **25** that serves as insertion detecting means and the stopper member **27** that serves as the case-locking mechanism will be described later.

Next, a state where the power-feeding connector **1** is operated is described hereinafter. FIG. **2** illustrates the power-feeding connector **1** in which the holding member is moved, and particularly FIG. **2** (*a*) is a side view and FIG. **2** (*b*) is a cross-sectional side view.

As described above, in the normal state, the holding member **3** is locked by the case **9** and the stopper member **27**. When the slider **25** is pushed inwardly (in a direction of the arrow A in FIG. **2** (*b*)) from the normal state, the stopper member **27** is pushed and moved by the slider **25**. In this process, the holding member **3** and the case **9** are unlocked by the movement of the stopper member **27**.

In a state where the holding member **3** and the case **9** are unlocked, when the holding member **3** is moved forward with respect to the case **9** (in a direction of the arrow C in FIG. **2** (*b*)), the connecting part **15***a* that is coupled with the holding member **3** (the connector bar **16**) is pushed forward. The connecting part **15***a* moves forward, and accordingly the arm **13** rotates on the pin **23***a* that serves as a rotation axis (in a direction of the arrow D in FIG. **2** (*b*)). When the arm **13** rotates, the connector body **11** that is coupled with the arm **13** by the connecting part **15***b* moves in the same direction as that of the holding member **3** (in a direction of the arrow E in FIG. **2** (*b*)).

Because the position where the holding member **3** couples with the arm **13** is different from the position where the connector body **11** couples with the arm **13**, a movement distance of the holding member **3** with respect to the case **9**

and that of the connector body **11** with respect to the case **9** differ with each other. Specifically, in the case where the ratio of distances from the pin **23***a* to the connecting part **15***a* and to the connecting part **15***b* is 2:1, if the movement distance of the holding member **3** with respect to the case **9** is set to be 2, the connector body **11** moves a distance of 1. That is, the mechanism such as the arm **13** functions as a speed reduction mechanism.

Furthermore, when the holding member **3** moves forward with respect to the case **9**, the engaging part **17***b* and the engaging part **21** are engaged with each other. Consequently, the locking member **17** rotates on the pin **23***b* that serves as a rotation axis. In other words, when the engaging part **17***b* that is one of the sides of the locking member **17** is pushed downwardly, the locking member **17** rotates and then the locking pin **17***a* that is the other side of the locking member **17** is pushed upwardly. Thereby, the locking pin **17***a* projects through the hole toward the outside of the case **9** (in a direction of the arrow G in FIG. **2** (*b*)). The locking member **17** may be configured with a spring, etc. so as to always resume the state illustrated in FIG. **2** (the state where the engaging part **17***b* is pushed downwardly).

Furthermore, when the holding member **3** moves forward with respect to the case **9**, the locking pin **7***a* of the operating part **7** moves toward a direction of the concave part **19** and then the locking pin **7***a* is engaged with the concave part **19**. Consequently, the operating part **7** rotates on the pin **23***c* that serves as a rotation axis. In other words, when the locking pin **7***a* is pushed downwardly, the operating part **7** rotates and then the other end portion of the operating part **7** is pushed upwardly (in a direction of the arrow F in FIG. **2** (*b*)). The operating part **7** may be configured with a spring, etc. so as to always resume the state illustrated in FIG. **2** (the state where the locking pin **7***a* is pushed downwardly).

When the locking pin **7***a* engages with the concave part **19**, movement of the holding member **3** with respect to the case **9** is locked. That is, the operating part **7** functions as locking means to prevent the holding member **3** (and the connector body **11**) from moving with respect to the case **9**. Furthermore, the operating part **7** functions as an unlocking mechanism to unlock the locked state by being operated (the outer end portion of the operating part **7** is pushed downwardly). With the configuration above, a connection state of the connector can be successfully maintained as well as it can be easily unlocked.

A display part that displays a position of the operating part **7** may be provided on an upper portion of the handle **5**. For example, the operating part **7** is in a state where a side of the locking pin **7***a* thereof is pushed upwardly in the normal state illustrated in FIG. **1**. Accordingly, in the state above, the operating part **7** rotates in a right-handed direction of FIG. **1** on the pin **23***c* that serves as an axis. On the other hand, in the state illustrated in FIG. **2**, a side of the locking pin **7***a* of the operating part **7** is pushed downwardly. Accordingly, the operating part **7** rotates in a left-handed direction of FIG. **2** on the pin **23***c* that serves as an axis.

Here, a hole is provided as the display part on a part of the holding member **3** so that a state of the operating part **7** can be recognized through the display part. With this configuration, whether the power-feeding connector **1** is in a locked state (the state illustrated in FIG. **2**) or in an unlocked state (the normal state) can be easily viewed. Other methods for viewing a state of the operating part **7** and other arrangements of the display part may be applied herein.

Furthermore, a parallel linkage may be used in a portion where the holding member **3** (or the connector body **11**) slides on the case **9**. By using the parallel linkage, the backlash hardly occurs when the holding member **3** (or the connector body **11**) slides on the case **9**, and it is possible to restrict a movement range therebetween.

Next, a method for using the power-feeding connector **1** will be described hereinafter. FIG. **3** to FIG. **5** illustrate processes of connecting the power-feeding connector **1** and a power-receiving connector **33**, and particularly FIG. **3** (*a*) to FIG. **5** (*a*) are cross-sectional side views and FIG. **3** (*b*) to FIG. **5** (*b*) are bottom perspective views illustrating operations of the slider **25**, etc.

First, as illustrated in FIG. **3** (*a*), the power-feeding connector **1** in the normal state is set to face to the power-receiving connector **33** that is to be connected. Specifically, a front end of the case **9** is inserted into a concave part of the power-receiving connector. Here, the power-receiving connector **33** accommodates a connector body **37** in the inside thereof. In the state above, there is a space between the connector bodies **11** and **37** so that a female terminal of the connector body **11** and a male terminal of the connector body **37** are not connected with each other.

Accordingly, as illustrated in FIG. **3** (*b*), a front end of the slider **25** does not touch the power-receiving connector **33** but projects forward from the case **9**. The slider **25** is always urged forward (in a direction of the arrow H in FIG. **3** (*b*)) by an elastic member **29** that is provided in the inside of the case **9**. That is, the slider **25** always projects forward whenever the power-feeding connector **1** is in the normal state.

The stopper member **27** is provided on a back end of the slider **25**, in the inside of the case **9**. The stopper member **27** is pressed in a direction of the connector bar **16** (that is, in a direction perpendicular to a sliding direction of the slider **25**) by an elastic member **31** (in a direction of the arrow I in FIG. **3** (*b*)). As illustrated in FIG. **3** (*b*), for example, a side surface of the stopper member **27** touches a pin **32** of the connector bar **16**. Accordingly, the stopper member **27** prevents the connector bar **16** from moving further forward, and thereby the movement of the holding member **3**, on which the connector bar **16** is fixed, with respect to the case **9** is restricted and the holding member **3** is stopped.

For example, even when the case **9** is inserted diagonally into the power-receiving connector **33** or even when the case **9** touches a periphery part of the power-receiving connector **33**, the slider **25** and the stopper member **27** prevent the holding member **3** from moving forward with respect to the case **9**. That is, in the case where the stopper member **27** that serves as the case-locking mechanism is in a locked state, even if the holding member **3** is inserted, the case **9** is not pushed inwardly to the holding member **3**.

A part of the slider **25** can be viewed through the hole **24**. That is, in a state where the slider **25** projects forward, by marking or coloring a position that corresponds to a position of the hole **24**, it is possible to visually recognize through the hole **24** that the slider **25** projects forward.

Furthermore, a concave part **35** is formed at a position of an inner surface of the power-receiving connector **33**, which corresponds to a position of the locking pin **17***a* in a state where the case **9** is arranged on the part of the power-receiving connector **33**. In order to position the locking pin **17***a* with the concave part **35** or position the female terminal with the male terminal described above, a guide, etc. for positioning the case **9** with the power-receiving connector **33** may be formed on an outer surface of the case **9**.

Secondly, as illustrated in FIG. **4**, when the holding member of the power-feeding connector **1** is pushed to a side of the power-receiving connector **33** (in a direction of the arrow C in FIG. **4** (*a*)), the step of the case **9** contacts the periphery part of the power-receiving connector **33**. The slider **25** projects on

the step of the case **9**, and accordingly the slider **25** touches the periphery part of the power-receiving connector **33**.

Therefore, as illustrated in FIG. **4** (*b*), the slider **25** is pushed backwardly (toward the inside of the case **9**, in a direction of the arrow A in FIG. **4** (*b*)) while resisting to a forward pressing force by the elastic member **29**. The back end of the slider **25** touches the stopper member **27**. A taper part **27***a* is formed on a surface where the stopper member **27** touches the slider **25**.

Accordingly, when the slider **25** moves backwardly (in the direction of the arrow A in FIG. **4** (*b*)), the back end of the slider **25** slides on the taper part **27***a* and then a movement direction of the stopper member **27** is changed. That is, the stopper member **27** moves substantially perpendicular to the sliding direction of the slider **25** (in a direction of the arrow B in FIG. **4** (*b*)) while resisting to a pressing force by the elastic member **31**. The stopper member **27** moves away from the pin **32**, and thereby the stopper member **27** and the pin **32** (the connector bar **16**) that have been engaged with each other are unlocked.

The insertion detecting means for detecting whether the case **9** is inserted into the power-receiving connector **33** are not limited to the slider **25** illustrated in the drawings, however, any mechanisms may be applied as long as they work when the case **9** is inserted. Furthermore, a mechanism for unlocking the case-locking mechanism at the time of detection by the insertion detecting means needs not necessarily be the stopper member **27** illustrated in the drawings, however, any mechanisms may be applied as long as they can unlock the engaged state in response to results detected by the insertion detecting means.

As described above, the state where the case **9** and the holding member **3** are engaged with each other is unlocked by inserting the case **9** into the power-receiving connector **33** completely, which makes it possible to allow the case **9** and the holding member **3** to move freely. A part of the slider **25** can be viewed through the hole **24**. That is, in a state where the slider **25** is pushed backwardly, by marking or coloring a position that corresponds to a position of the hole **24**, it is possible to visually recognize through the hole **24** that the slider **25** is pushed backwardly. In this way, it is possible to visually recognize that the case **9** is successfully inserted into the power-receiving connector **33**.

Thirdly, as illustrated in FIG. **5**, the holding member **3** of the power-feeding connector **1** is further pushed to the side of the power-receiving connector **33** (in a direction of the arrow C in FIG. **5** (*a*)). The holding member **3** cannot be pushed any further because the case **9** touches the power-receiving connector **33**. On the other hand, the state where the holding member **3** is stopped with respect to the case **9** is unlocked. Accordingly, as illustrated in FIG. **5** (*b*), the pin **32** does not touch the stopper member **27**. The connector bar **16** does not touch the stopper member **27**, and thus moves forward (in a direction of the arrow C in FIG. **5** (*b*)).

In this way, it is possible to move the holding member **3** forward with respect to the case **9**. In this process, the connector body **11** moves forward (in a direction of the arrow E in FIG. **5**) with respect to the case **9** with the movement of the holding member **3**. The connector body **11** projects from a front portion of the case **9**, and accordingly it is connected to the connector body **37** of the power-receiving connector.

Here, in the case where the ratio of movement distances from the holding member **3** to the case **9** and from the connector body **11** to the case **9** is set to be 2:1, the holding member is pushed from a distance twice as far as a space length for connection between the connector bodies **11** and **37**, and thereby the connector body **11** can move a distance enough for the connectors to be connected. In other word, the connectors can be connected by pushing the holding member **3** with half force of force for connecting the connectors (that is resisting force for connection). The speed reducing ratio of the speed reduction mechanism is set arbitrarily considering resisting force for connection or user-friendliness.

In a state illustrated in FIG. **5** (*a*), as described above, the locking pin **17***a* is engaged with the concave part **35**. Consequently, the power-receiving connector **33** and the power-feeding connector **1** are locked in a state where they are connected with each other. Furthermore, the locking pin **7***a* formed at an end portion of the operating part **7** is engaged with the concave part **19**, and thereby the holding member **3** is locked so that it does not move with respect to the case **9**. Therefore, even when a cable, etc. (not shown) is pulled, the power-feeding connector **1** is not easily disconnected from the power-receiving connector **33**.

In order to disconnect the power-feeding connector **1**, it is necessary to unlock the engaged locking pin **17***a* by the process in which the holding member **3** is pulled back in a state where the locking pin **7***a* is pushed upwardly by pushing the end portion of the operating part **7** so that the engaging part **17***b* moves onto the engaging part **21**. By this process, the power-feeding connector **1** can be easily disconnected.

In the example described above, a pair of the slider **25** and the stopper member **27** is arranged therein, however, the present invention is not limited to this arrangement. For example, as illustrated in FIG. **6**, a plurality of the sliders **25** (and the corresponding stopper members **27**, etc.) may be arranged therein.

When a plurality of the sliders **25** is arranged therein, they are desired to be arranged at point symmetrical positions relative to a connector center **39** that is a center of the connector body **11** (the case **9**) in a front view of the connector body **11**. With this configuration, it is possible to insert the case **9** into the power-receiving connector **33** accurately because a pushing force of the sliders **25** is applied equally on the connector center **39**.

As described above, the power-feeding connector **1** according to this embodiment does not require a great force and is easily connected to a power-receiving connector. Especially by using the power-feeding connector **1**, an operator is able to understand connecting procedures easily and sensually because a direction to which an operator pushes the holding member is the same as a connecting direction of the connector body **11**.

Furthermore, the case-locking mechanism that locks the case **9** and the holding member **3** is provided therein, and accordingly the holding member **3** does not move with respect to the case **9** in the normal state. In this way, the holding member **3** does not move with respect to the case **9** in a state where the case **9** is not completely inserted into the power-receiving connector **33**.

Furthermore, because the speed reduction mechanism is provided for the movement of the holding member **3** and the connector body **11** with respect to the case **9**, the force required to connect the connectors with each other can be reduced. Still further, when the speed reduction mechanism is used with the case-locking mechanism described above, the speed reduction mechanism does not work before inserting the case **9** into the power-receiving connector **33** but works after the case **9** is completely inserted into the power-receiving connector in order to connect the connectors with each other.

Furthermore, because the slider **25** is used as the insertion detecting means, it is possible to successfully detect that the case **9** is inserted into the power-receiving connector **33** with

a simple configuration. Still further, because a position of the slider **25** can be viewed through the hole **24** that is formed in the case **9**, it is possible to visually recognize whether the slider **25** is successfully pushed. That is, it is able to visually recognize whether the case **9** is completely inserted into the power-receiving connector **33**.

Next, a second embodiment according to the present invention will be described below. FIG. **7** to FIG. **9** illustrate processes for connecting a power-feeding connector **40** according to the second embodiment to the power-receiving connector **33**, and particularly FIG. **7**(*a*) to FIG. **9** (*a*) are cross-sectional side views and FIG. **7** (*b*) to FIG. **9** (*b*) are bottom perspective views illustrating operations of a switch, etc. In the second embodiment, the same numerals as those of FIG. **1** to FIG. **5** are allotted to configurations having the same functions as those illustrated in FIG. **1** to FIG. **5**, and the overlapping explanations will be omitted.

The power-feeding connector **40** is configured in substantially the same manner as the power-feeding connector **1**, however, there are differences in the insertion detecting means and the case-locking mechanism. The power-feeding connector **40** includes a switch **41** and a stopper member **45**, etc. instead of the slider **25** and the stopper member **27**, etc.

As illustrated in FIG. **7** (*b*), the switch **41** as an insertion detecting part is provided at the step of the case **9**. The switch **41** is provided with a pin **43** that can slide in an axial direction (a movement direction of the case **9** as well as an inserting and removing direction of the connector). An end of the pin **43** projects forward and is pushed from the front portion of the case **9** (in a direction of the arrow J in FIG. **7** (*b*)). The switch **41** is a known switch such as a limit switch and a proximity switch, and any switches may be applied as long as the switch can detect that the pin **43** is pushed into a body of the switch **41**.

A hole **49** is provided in the connector bar **16**. The stopper member **45** is arranged toward a direction vertical to the axial direction (the movement direction of the case **9** as well as the inserting and removing direction of the connector) at a position to which the hole **49** corresponds in the normal state, in the inside of the case **9**. The stopper member **45** can be actuated by electromagnetic solenoid, etc to operate the pin **47**. That is, by operating the stopper member **45**, it is possible to insert and remove the pin **47** with respect to the hole **49**.

In the normal state, that is, in the case where the pin **43** of the switch **41** is pushed forward, the pin **47** of the stopper member **45** is maintained with being inserted into the hole **49** (in a direction of the arrow K in FIG. **7** (*b*)). In this state, because the pin **47** is inserted into the hole **49**, the connector bar **16** is stopped by the stopper member **45**. Accordingly, the holding member **3** cannot move with respect to the case **9**.

Secondly, as illustrated in FIG. **8**, when the holding member **3** of the power-feeding connector **40** is pushed toward the side of the power-receiving connector **33** (in a direction of the arrow C in FIG. **7** (*a*)), the step of the case **9** contacts the periphery part of the power-receiving connector **33**. The pin **43** projects on the step of the case **9**, and accordingly the pin **43** contacts the periphery part of the power-receiving connector **33**.

Therefore, as illustrated in FIG. **8** (*b*), the pin **43** is pushed backwardly (into the inside of a body of the switch **41**, in a direction of the arrow L in FIG. **8** (*b*)). When the pin **43** is pushed backwardly, the switch **41** actuates the stopper member **45** and then the pin **47** is removed from the hole **49** (in a direction of the arrow M in FIG. **8** (*b*)). Accordingly, the state where the connector bar **16** is stopped by the stopper member **45** is unlocked.

Thirdly, as illustrated in FIG. **9**, the holding member **3** of the power-feeding connector **40** is further pushed to the side of the power-receiving connector **33** (in a direction of the arrow C in FIG. **9** (*a*)). As described above, the holding member **3** cannot be pushed any further because the case **9** touches the power-receiving connector **33**. On the other hand, the state where the holding member **3** is stopped with respect to the case **9** is unlocked. That is, as illustrated in FIG. **9** (*b*), the connector bar **16** does not touch the stopper member **45** (the pin **47**), and thus the connector bar **16** moves forward (in a direction of the arrow C in FIG. **9** (*a*)).

In this way, it is possible to move the holding member **3** forward with respect to the case **9**. In this process, the connector body **11** moves forward (in a direction of the arrow E in FIG. **9** (*a*)) with respect to the case **9** with the movement of the holding member **3**. The connector body **11** projects from the front portion of the case **9**, and accordingly it is connected to the connector body **37** of the power-receiving connector.

According to the power-feeding connector **40** of the second embodiment, it is possible to obtain the same effect as that of the power-feeding connector **1**. Furthermore, only a small force is required at the time of inserting the connector because the stopper member **45** is actuated by an electrical signal from the switch that is used as the insertion detecting means.

The embodiments are described above with reference to the attached drawings, however, the technical scope of the present invention is not limited by the embodiments above. It is obvious that a person skilled in the art can easily make the various examples of change or modifications within the category of the technical idea described in the claim, and moreover, it is understood that such examples naturally belong to the technical scope of the present invention.

For example, the shape of the holding member **3** and the arrangement of each constituent elements in the inside of the case **9** and the shape thereof are not limited to the examples illustrated in the drawings.

## DESCRIPTION OF NOTATIONS

**1**, **40** power-feeding connector
**3** holding member
**5** handle
**7** operating part
**7***a* locking pin
**9** case
**11** connector body
**13** arm
**15***a*, **15***b* connecting part
**16** connector bar
**17** locking member
**17***a* locking pin
**17***b* engaging part
**19** concave part
**21** engaging part
**23***a*, **23***b*, **23***c* pin
**24** hole
**25** slider
**27**, **45** stopper member
**27***a* taper part
**29** elastic member
**31** elastic member
**32** pin
**33** power-receiving connector
**35** concave part
**37** connector body
**39** connector center
**41** switch

**43** pin
**47** pin
**49** hole
**100** power-feeding connector
**101** connector body
**103** handle

The invention claimed is:

**1**. A power feed connector used for an automobile, comprising:
a connector body;
a case that accommodates the connector body therein;
a holding member that is attached to the case; and
a case-locking mechanism that restricts a movement of the case with respect to the holding member, wherein
the holding member has a handle at one of the end portion thereof,
the handle is formed such that at least a part of the handle is set on an extended line of a central axis of the connector body,
the connector body and the holding member are slidable in a substantially same axial direction with respect to the case when the case-locking mechanism is unlocked, and
the connector body is movable forward with respect to the case with a movement of the holding member when the holding member moves forward with respect to the case in a state where the case-locking mechanism is unlocked.

**2**. The power feed connector according to claim **1**, wherein
a speed reduction mechanism is provided in the holding member and the holding member and the connector body move with respect to the case via the speed reduction mechanism, and
when the holding member moves with respect to the case, a movement distance of the connector body with respect to the case becomes smaller than a movement distance of the holding member with respect to the case.

**3**. The power feed connector according to claim **1**, further comprising insertion detecting means that detect the case is inserted into a power-receiving connector, wherein
the insertion detecting means are configured to unlock the case-locking mechanism when detecting that the case is inserted into the power-receiving connector.

**4**. A power feed connector used for an automobile, comprising:
a connector body;
a case that accommodates the connector body therein;
a holding member that is attached to the case; and
a case-locking mechanism that restricts a movement of the case with respect to the holding member, wherein
the connector body and the holding member are slidable in a substantially same axial direction with respect to the case when the case-locking mechanism is unlocked,
the connector body is movable forward with respect to the case with a movement of the holding member when the holding member moves forward with respect to the case in a state where the case-locking mechanism is unlocked,
the insertion detecting means include
a slider that is formed slidably in an inserting and removing direction of the case, on a portion of the case which inserts into the power-receiving connector, and
an elastic member that urges the slider in an inserting direction of the case,
the case-locking mechanism is a stopper member that locks the case and the holding member, and
when the slider touches the power-receiving connector and is pushed inwardly to the case, the stopper member moves so that the case-locking mechanism is unlocked.

**5**. The power feed connector according to claim **4**, wherein a plurality of sliders is arranged symmetrically with each other against a central axis of the connector body.

**6**. The power feed connector according to claim **4**, wherein the case is provided with a hole, and a position of the slider in an inside of the case is viewed through the hole.

**7**. A power feed connector used for an automobile, comprising:
a connector body;
a case that accommodates the connector body therein;
a holding member that is attached to the case;
a case-locking mechanism that restricts a movement of the case with respect to the holding member; and
insertion detecting means that detect the case is inserted into a power-receiving connector, wherein
the connector body and the holding member are slidable in a substantially same axial direction with respect to the case when the case-locking mechanism is unlocked,
the connector body is movable forward with respect to the case with a movement of the holding member when the holding member moves forward with respect to the case in a state where the case-locking mechanism is unlocked,
the insertion detecting means are configured to unlock the case-locking mechanism when detecting that the case is inserted into the power-receiving connector,
the insertion detecting means include
a pin that is formed slidably in an inserting and removing direction of the case, on a portion of the case which inserts into the power-receiving connector,
an elastic member that urges the pin in an inserting direction of the case, and
a switch that detects the pin resists the elastic member and is pushed,
the case-locking mechanism is a stopper member that locks the case and the holding member and is actuated by electromagnetic solenoid, and
when detecting that the pin touches the power-receiving connector and is pushed inwardly to the case, the switch actuates the electromagnetic solenoid to move the stopper member so that the case-locking mechanism is unlocked.

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